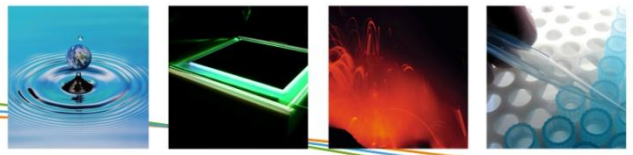
vito

vision on technology



22/11/2011

MNA workshop Techniques and Research

Snowman, Paris, November 7, 2011

MNA … Latest developments in techniques

- Abiotic conversions of contaminants by soil minerals
- Molecular analyses by PCR and QPCR
- Stable isotope analyses (CSIA)
- *In-situ microcosms (eg Bactrap* tool) for field evaluation of potential for MNA
- Measuring fluxes versus point concentrations
- Reactive transport modeling
- Treatment trains : Combining MNA with ENA and/or source removal

MNA … Latest developments in techniques

- Abiotic conversions by soil minerals or hydrolysis
- For CAH or Cr(VI) by minerals that contain reduced iron eg FeS
  - Relevance? Relative degradation rates?
  - Sometimes considered

- Molecular analyses by PCR and QPCR
  - DNA (including dead material)
    - Established technology, eg Dehalococccoides genes, VC-reductases
    - R&D needs?
      - Other pathways (microbes, enzymes)?
      - Other pollutants eg MTBE? 1,1-DCA?
      - Overview of commercial labs and specification of relevant primers needed

MNA … Latest developments in techniques

- Stable isotope analyses (CSIA)
  - not only C, but also H, N and Cl stable isotopes
  - Evidence for occurence of NA and potentially also on extent of biodegradation
    - Fractionation factors depend on specific bacteria that may degrade the same pollutants
    - Different enrichment factors for different steps in sequential and paralel degradation patways (modeling required?)
    - Multiple sources are real problem. What about shifts in NAPls?
    - Expert knowledge required (uncertainties) → guidance needed & training?
      - EPA Guide on CSIA (2008)
    - How convincing? Variable outcome in the field. Survey of experience?

MNA … Latest developments in techniques

- *In-situ microcosms (eg Bactrap* tool) for field evaluation of potential of NA
  - In-situ sorbent samplers to demonstrate presence of suitable microbiology :
  - QPCR of specific catabolic genes;
  - phospholipid analyses
  - In situ evaluation of pollutant degradation with stable isotope modified substrates & analyses
  - Typical in well, I.e. in groundwater only → representative for soil?
  - Recent development → Inventory of experience?
- Laboratory tmicrocosm tests
- Wider analytical scope (TEA, all metabolites)
- Closed mass balance
- Flexibe setup allows for manipulations
- Abiotic conversions by soil can be taken into account
- Strict anaerobic execution critical, representative sample locations

Under-recognized pollutants?

- More important for MNA than for active remediation

- Chlorinated aliphatics:
  - 1,2,3-TCP (trichloro-propane)
  - 1,4-dioxane (recalcitrant)
- petroleum hydrocarbons
  - Trimethylbenzenes
  - MTBE (recalcitrant), ETBE, TBA (accumulates)
- MGP sites
  - NSO heterocyclic compounds
  - Phenols, chresols, thiocyanate
- Dissolved As and Mn in reduced groundwater plumes as result of MNA-processes

Reactive transport modeling & mass balance

- Simple (one dimensional) models , eg Bioscreen
  - Used more often in USA → satisfactory or too simplistic?

- More extensive models eg RT3D
  - Used less frequently (costly)
  - When required?
  - Only for complex sites when it allows for reduction of the intensity of the monitoring programme

Sustainability of MNA?

- Balance between contaminant mass and electron acceptor or electron donor availability
- Measure eg bio-available iron(III) for MNA of TPH and carbon sources for CAH?
- Estimation of mass flux from source area into plume and its evolution in time?
  - Processes
  - Measurement
  - Modeling?
  - This risks of becoming too complicated for average sites?
- What if environmental conditions are not stable?

  change in direction of groundwater;

  stability of reduced metal precipitates (MS, Cr(III))?

Mass fluxes for assessment of MNA
MNA in the vadose zone?

- Fluxes of contaminants versus TEA/EA are useful for mass balance estimation (mass/time)
- Measurement of fluxes more complicated/expensive
  - By pumping planes?
  - By other methods? (passive samplers)?
  - Beware of puching too many holes in sites!

- MNA of contaminant vapours in the vadose zone?
  - Methods available?
    - Eg concentration trends by soil gas measurement
    - Incorporated in existing protocols?
    - Again risk of additional preferential pathways

MNA in treatment trains

- Trend: application of MNA as passive part of treatment train, eg
  - active source removal and MNA for plume
  - ENA for plume followed by MNA to reduce cleanup time frames

  - Need for protocols to decide when to combine and when to switch over from ENA to MNA? Or source removal → ENA → MNA
  - Differentiation of protocols for technology screening and monitoring in early phase and long term?
  - Becomes too complicated?

Additional comments

- Risk-based final remediation goals are important (policy)
- List of acceptance criteria for MNA in different countries would be useful
- Develop a European MNA Protocol
- Checklist of techniques / a combination of techniques applicable with respect to monitoring , modelling, ecotoxicity tests;
- Application of passive samplers (both for chemical and microbiological data)
- Do the molecular analyses (MA) really gives a cost-effective surplus on understanding NA processes? Or can CSIA give all the answers instead?
- Development of tools for more heterogeneous aquifers f.i. karstic aquifers